English Translation of JP 59-8229

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SPECIFICATION

1. TITLE OF THE INVENTION

Thermal Fuse

2. CLAIMS

A thermal fuse characterized by consisting essentially of a fusible alloy and a thermosoftening resin having flux properties at a lower melting point than the melting point of the fusible alloy, having a constitution such that said fusible alloy is spheroidized and blown out with an action of surface tension at a higher temperature than a predetermined temperature, and in that a metallic composition of said fusible alloy comprises 42 to 44% by weight of tin, 51 to 53% by weight of indium and 4 to 6% by weight of bismuth.

3. DETAILED DESCRIPTION OF THE INVENTION

The present invention relates to a thermal fuse of a surface tension action type consisting essentially of a fusible alloy and a thermosoftening resin.

The structure of a thermal fuse utilizing an action of surface tension is of the kinds shown in Figs. 1 and 2. Fig. 1 shows a thermal fuse such that terminal wires 2, 2′ are connected to both ends of a fusible alloy 1, whose surface is coated with

a thermosoftening resin 3 having flux properties at a lower melting point than the melting point of the fusible alloy 1, and stored in an insulation case 4 and then sealed up with an insulating coating 5. In addition, Fig. 2 shows a thermal fuse such that an insulation covering 6 is provided for the outer periphery of a fuse element in which a fusible alloy 1 and a thermosoftening resin 3 having flux properties at a lower melting point than the melting point of the fusible alloy 1 are pulverized and dispersed, and connected to terminal wires 2, 2′ and then sealed up with an insulating coating 5. When these thermal fuses reach a predetermined temperature, the fusible alloy 1 is melted as shown in Figs. 3 and 4, and attracted and blown out in the terminal direction of the opposite terminal wires 2, 2′ with an action of surface tension. Such a thermal fuse of a surface tension action type can be made into a thermal fuse of a minimum size by contriving the wire diameter and length of the fusible alloy, or the diameter and length of the fuse element in which the fusible alloy and the thermosoftening resin are pulverized and dispersed.

Fig. 5 shows a thermal fuse such that a fusible alloy 1 is welded and joined to the tips of spring plate terminals 7, 7′, and sealed up with an insulation vessel 8 and an insulation stator 9; a thermal fuse of an outdated elastic force action type such that when the thermal fuse reaches a predetermined temperature, the fusible alloy 1 is melted as shown in Fig. 6,

and the spring plate terminals 7, 7′ are linearly restored by elastic force to open a conducting path. A thermal fuse of this kind includes a type utilizing a spring. These thermal fuses of an elastic force action type have a defect of causing cracks due to shock, vibration or the like for the reason that the force of a spring acts constantly so as to separate the fusible alloy portion.

Today, the downsizing of a thermal fuse to be incorporated thereinto is also required in accordance with the downsizing of electronic equipment, and the demand for a thermal fuse of a small-sized surface tension action type superior in economical productivity is increasing in substitution for a thermal fuse of a large-sized elastic force action type utilizing an outdated spring.

Conventionally, tin, bismuth, cadmium and a composition of those metals have been known as a fusible alloy for a thermal fuse having a melting point of approximately 110°C; for example, a fusible alloy having a melting point of 103°C and a composition of 25.9% by weight of tin, 53.9% by weight of bismuth and 20.2% by weight of cadmium. This fusible alloy has bismuth as the main component, and hard and fragile properties. That is to say, the fusible alloy is inferior in machinability such as extrudability, rolling quality, wire drawability and punching quality, so that it can not be processed into a linear or platy body in a long, slender and thin shape. This fusible alloy has

a defect such that the high electric resistance causes current capacity to be decreased. In addition, high content of cadmium has a harmful influence on the human body during handling work, so that it is not preferable for use. In particular, a technique for manufacturing by pulverizing and dispersing as shown in Fig. 2 has a greater harmful influence on the human body.

As described above, a conventional fusible alloy is not appropriate by reason of having some defect in the case of being used for a thermal fuse of a small-sized surface tension action type, and is appropriate only for a thermal fuse of an elastic force action type utilizing an outdated spring.

In order to cope with such problems, the object of the present invention is to provide a high-function thermal fuse of a surface tension action type structured as shown in Figs. 1 and 2 employing a fusible alloy, which is superior in machinability such as extrudability, rolling quality, wire drawability and punching quality, and has low and stable electric resistance with time, and a small harmful influence on the human body, and additionally performance for being capable of accurately exhibiting high surface tension during blowout, and then to provide a thermal fuse of a minimum size easily and inexpensively meeting the downsizing of a thermal fuse required in accordance with the present development of electronic equipment.

The present invention is hereinafter described on the basis

of examples. 43% by weight of tin, 52% by weight of indium and 5% by weight of bismuth were added together and melted by heating to obtain a fusible alloy of 110°C. This was processed into a wire diameter of 0.8 mm × 4 mm to manufacture a thermal fuse of a surface tension action type of a model shown in Fig. 1 by 10 pieces, to whose both ends a terminal wire was connected and to whose outer periphery a thermosoftening resin with a softening point of 85°C was applied. An electric current of 100 mA was passed through this thermal fuse in an air oven at a rate of temperature rise of 1°C/minute from 90°C to measure blowout temperature thereof. The results are shown in the following Table 1.

Table 1

Sample No.	1	2	3	4	5	6	7	8	9	10	Average Value	Dispersion
Blowout Temperature (°C)	110.1	110.4	110.2	110.2	110.6	109.5	110.4	109.9	110.6	109.6	110.15	1.1

This thermal fuse was further subject to a test in which a vibration with an amplitude of 1.5 mm and a reciprocation between frequencies of 10 and 50 Hz in 20 minutes was added thereto in horizontal and vertical directions for 2 hours each to measure electric resistance before and after the test. The results are shown in the following Table 2 (the electric resistance is a measured value in passing an electrical current of 100 mA through a length of approximately 15 mm between the terminal wire-the fusible alloy-the terminal wire).

Table 2

Sample No.	1	2	3	4	5	6	7	8	9	10	Average Value
Before Test (mΩ)	2.31	2.27	2.34	2.28	2.30	2.30	2.29	2.31	2.31	2.36	2.307
After Test (mΩ)	2.32	2.27	2.33	2.29	2.30	2.30	2.28	2.30	2.31	2.36	2.306

It is understood from the above that a small-sized thermal fuse of surface tension action type according to the present invention has accurate and stable blowout properties as clearly in Tables 1 and 2, performance superior in responsibility for ambient temperature, and stable performance with no change of electric resistance against shock resistance and vibration resistance.

As described above, a thermal fuse of a surface tension action type according to the present invention employing a fusible alloy with a melting point of 107 to 113°C comprising 42 to 44% by weight of tin, 51 to 53% by weight of indium and 4 to 6% by weight of bismuth has favorable blowout properties, low electric resistance and superior machinability, and can be handled without anxiety and the formation of a special step in manufacturing by reason of not containing components such as cadmium; thus the thermal fuse is of such a great industrial value as to be capable of inexpensively providing a small-sized highly-reliable thermal fuse.

4. BRIEF DESCRIPTION OF DRAWINGS

Figs. 1 and 2 are each a cross-sectional view of a thermal fuse of a surface tension action type, Figs. 3 and 4 are each a cross-sectional view of the thermal fuse in Figs. 1 and 2 after being blown out, Fig. 5 is a cross-sectional view of a thermal fuse of an elastic force action type, and Fig. 6 is a

cross-sectional view of the thermal fuse in Fig. 5 after being blown out.

1 … fusible alloy, 2, 2′ … terminal wires, 3 … thermosoftening resin, 4 … insulation case, 5 … insulating coating, 6 … insulation covering, 7, 7′ … spring plate terminals, 8 … insulation vessel, 9 … insulation stator.

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Fig. 1

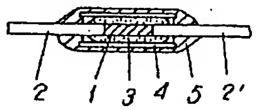

Fig. 2

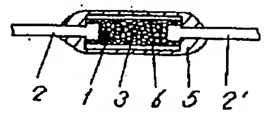

Fig. 3

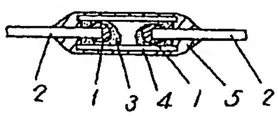

Fig. 4

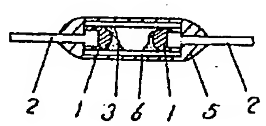

Fig. 5

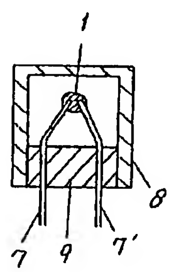

Fig. 6